

Rhodora

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CONTENTS:

Roses vs. Railroads. <i>G. T. Moore</i>	93
Contributions from the Cryptogamic Laboratory of Harvard University, — LV. Mycological Notes 1-2. <i>R. Thaxter</i> .	97
Recently Recognized Species of <i>Crataegus</i> , — II. <i>C. S. Sargent</i> .	108
An Interesting Form of <i>Leersia oryzoides</i> . <i>A. A. Eaton</i> . .	118
Western Plants in Cumberland, Maine. <i>E. B. Chamberlain</i> .	118
<i>Linum catharticum</i> on Cape Breton. <i>M. L. Fernald</i> . . .	119
Meeting of the Vermont Botanical Club. <i>L. R. Jones</i> . . .	120

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ROSES VS. RAILROADS.

GEORGE T. MOORE.

WHILE it is not often that botanists and horticulturists have occasion to testify in court, at least in a technical way, it is satisfactory to know that recently when such testimony was given it resulted in a most decided victory for the growers of flowers and helped establish a principle which cannot but have considerable influence upon any future case involving the question of damage to plants by smoke and poisonous vapors. The facts which resulted in the bringing of such a suit were as follows:

The New York, New Haven and Hartford Railroad Company, while making some general improvements in the vicinity of their station at Woods Hole, Massachusetts, decided upon the removal of an old engine house, which had outlived its usefulness. After this building had been torn down and most of the material disposed of, there still remained an old tar and gravel roof, which could be neither used nor given away and since it would probably have cost a few hundred dollars to transport this material to the ocean and sink it, it was decided to set fire to the mass and thus consume it without expense. Unfortunately for this bit of economy, there was in the immediate neighborhood one of the finest rose gardens in this country, formerly the property of Mr. J. S. Fay and now owned jointly by Miss Fay and Mr. M. H. Walsh.

To those who are familiar with the various exhibitions of roses which have taken place in Massachusetts and elsewhere within the last few years, the mere mention of such names as the Jubilee, the Lillian Nordica, the J. S. Fay, the Débutante, the Sweetheart and similar famous plants, all the result of Mr. Walsh's skill, will be quite

sufficient to establish his reputation as a grower and breeder of roses. The fact that he received the first gold medal ever awarded for a rose, together with his long list of first prizes and constant success as a gardener, is well known and that he was the part owner of a collection of roses and other plants that could not be duplicated, except under exceptional circumstances, will be readily admitted.

At the time of the destruction of the engine house, about the middle of May, 1901, Mr. Walsh had a large number of stock plants on hand, besides a climbing rambler, a hybrid tea and several other new garden roses, which gave great promise, and were conceded by all who had seen them to be of unusual beauty and superior worth.

When the burning of the rubbish from the engine house began, it was the source of considerable annoyance to those living in the vicinity, but it was not until the third and last day of the fire, when the tar roof was being consumed, that anything seemed decidedly wrong in the rose garden. At this time, the leaves began to fall from a number of plants, while those which remained, together with parts of the stems, became discolored and marked in various ways. So severe was this external evidence of damage, that for months afterwards the bushes which were able to survive showed large black and gray scars, much as though they had been actually scorched by fire.

One can readily imagine the alarm with which the owners of this wonderful garden viewed the destruction of their plants and the immediate efforts made to discover the cause of such havoc. For this it did not seem necessary to seek far. The amount of dense smoke and vapor that arose from the burning of the tar roofing was, of course, tremendous and when this cloud was carried by the prevailing wind directly upon the rose garden, settling there like some heavy black fog, it could hardly be supposed to be beneficial.

As has been said, the immediate effect of this unusual environment was to cause most of the leaves to drop off and to scar and mark the young and tender stems so as practically to ruin them for exhibition or other such purposes. But this proved to be the smallest part of the loss. As in any other case of poisoning from gases, the outward evidences were but slight as compared with the internal and actual damage done to the plants. Some were killed outright, while many of those which survived were so weakened that they were of no further use for propagation. Large areas of growing tissue died in most of the shoots exposed to the action of the smoke and this together with

the loss of foliage made it impossible for a number of plants to recover even under the most careful nursing. The bushes which survived were much more susceptible to the attack of fungus diseases and it is a question whether even those plants which seemed to be but slightly affected will ever be able to attain the perfection which they promised before being subjected to the fumes of the burning tar.

When complaint was made to the Railroad Company, they failed to appreciate that the roses had been damaged and declined to recognize their liability in the matter. Consequently, a suit for \$9,000 was brought, which was subsequently increased to \$25,000, Robert M. Morse and Henry M. Hutchings appearing for the plaintiffs and Thomas C. Day for the defendant.

It was soon recognized by the attorneys for the plaintiffs that however great the actual damage might be and whatever estimate competent horticulturists might place upon the value of the destroyed plants, the first and most necessary point was to establish the injurious effect of the smoke and vapor from burning tar upon rose plants and to demonstrate further that this effect was distinct from any produced by changes in the weather, the use of germicides, attacks of fungi, insects, or any other cause which might be put forward by the defendant. The damage which may be produced in plants by the action of sulphurous and carbolic acids, pyradins and other substances apt to be found in tar, is well known. Gardeners know to their cost the result of burning sulphur instead of merely vaporizing it, when attempting to fumigate greenhouses and the effect of a crystal of carbolic acid on a rose leaf is a simple yet convincing demonstration of the rapidity with which the plant is affected. It has been shown by careful experiments that one part of sulphurous acid in one million parts of air is sufficient to cause the death of an average rose-bush in a few hours and the action of the various hydrocarbons is but little less severe. An analysis of pieces of the tar roofing was made by Dr. A. H. Gill of the Institute of Technology and showed the presence of sulphur, phenols and other substances which, if burned, would generate poisonous vapors in sufficient quantity to damage or destroy any plant with which they remained in contact. A microscopical examination of the discolored leaves and stems from Mr. Walsh's roses showed very clearly that the killing action had been due to a poisonous gas rather than to the presence of a fungus or other foreign organism. The contents of the cells were shrunken

and distorted, the green coloring matter being completely disorganized and filled with small brown granules of "acid chlorophyl" which gave rise to the characteristic yellow and brown splotches upon the leaves and stems.

After it had been established by expert testimony that the effect of such vapors as would be generated by the burning of tar was identical with that produced in the plants of Miss Fay and Mr. Walsh, an attempt was made to fix as nearly as possible the actual money loss involved. Such well known authorities as Mr. B. M. Watson, Mr. John K. Farquhar, Mr. Robert Cameron, Mr. Wm. H. Elliott and others equally as competent testified as to the preëminent reputation of Mr. Walsh as a rose grower and the specific worth of the individual plants he had lost. Although there was the natural variation in the estimates that would be expected, where so many opinions were given independently, the average of all the estimates on the value of the roses damaged by poisonous gases amounted to \$5,543.47 on the plants of Miss Fay and \$15,596 on those belonging to Mr. Walsh. In addition to this sum it was maintained that Mr. Walsh was entitled to special damages for the loss of prizes which he would undoubtedly have received and for the loss of advertising due to his inability to exhibit and keep his flowers before the public as usual. These claims were allowed by the Auditor, who awarded \$21,989.32 as the total amount of damages sustained. The Railroad Company subsequently paid \$20,000 in settlement, without taking an appeal.

While somewhat similar cases involving the question of damage to vegetation due to certain noxious vapors have been tried in this country, no one has ever received anything like such a sum as was paid in this instance. As Mr. Morse, in his closing argument, said, "I need not say to the Auditor that this case is one of great importance. It is important in a certain sense to the profession, not only to the profession of law, but to the profession of florists, because no action involving so serious a damage to plants or flowers has ever arisen in this country, and, while there may not be much law to be settled by it, it still will always be of interest." Considering the dignified and unprejudiced manner in which the entire hearing was conducted and the fair and careful way in which the amount of damage was estimated, it certainly established a very strong precedent in favor of those who have large interests in the growing of flowers for either pleasure or profit.

WASHINGTON, D. C.

CONTRIBUTIONS FROM THE CRYPTOGAMIC LABORATORY OF HARVARD UNIVERSITY,—LV.

R. THAXTER.

MYCOLOGICAL NOTES, 1-2.

(Plate 46.)

1. **A New England Choanephora.** The genus *Choanephora* includes at present a small group of exceptionally interesting moulds which have hitherto been regarded as strictly tropical in their range; two of the three described species, *C. Simonsii* and *C. infundibulifera*, having been discovered in India by Dr. Cunningham, while the third, *C. Americana*, was found by Dr. Alfred Moeller in Brazil. The natural habitat of these fungi is on the fading flowers or even young tissues of flowering plants; but their chief interest lies in the fact that, although they are closely related to the *Mucors* or "bread moulds" and possess similar sporangia and zygospores, their most common and characteristic form of fructification is quite unlike that of any of their relatives and closely resembles the so-called conidial fructification of some of the higher fungi. This conidial type is often closely simulated by certain species of *Oedocephalum*, a "form genus" known to include imperfect conditions of both *Basidiomycetes* and *Ascomycetes*, and further bears a marked resemblance to species of *Rhopalomyces*, a genus the members of which are as yet unconnected with any perfect form. The fertile hypha of *Choanephora*, which is large and highly specialized, rises erect from the substratum on which it grows, and becomes distally enlarged to form a more or less clearly distinguished terminal head. But while in *Rhopalomyces*, and normally also in *Oedocephalum*, this primary head, by a process of budding, becomes completely covered by a layer of conidial spores, in *Choanephora* it normally gives rise to short radiating branchlets of variable number; which, after becoming distally swollen, produce the spores on the surfaces of the secondary heads thus formed. Fig. 1 of the accompanying plate will illustrate the general form of this fructification, although it gives but an inadequate idea of its striking and graceful appearance. The spores are dark, like those of *Rhopalomyces*, and it is of interest to note that *Rhopalomy-*

ces-like conditions not infrequently occur, in which the primary head gives rise directly to the spores. On the other hand it should be mentioned that in at least one described species of *Oedocephalum*,¹ Choanephora-like conditions may occur in which the primary heads, instead of producing spores, give rise to branchlets bearing sporiferous capitula.

Having been greatly interested in this genus, which at the time was only known to me through the description and figures of Cunningham, I was not a little surprised, about a dozen years since, to find growing on decaying squashes on the farm of Mr. Kendall, near the Cascades at Waverley, Mass., a fungus having exactly the characters of the conidial form of Choanephora. Since no such plant had ever been described from America, I was at first inclined to believe that it was a new species, but further search for it in the literature led to the conclusion that, notwithstanding the fact that its characters were quite unlike those of *Rhopalomyces*, it had been included in this genus by Berkeley as long ago as 1875, having been described in *Grevillea* under the name *R. cucurbitarum* from material on squashes sent by Ravenel from Lower Carolina. This conclusion was confirmed some years after by an examination of the type in the herbarium at Kew, for which privilege I was indebted to the kindness of Mr. Masee, who had already been so good as to favor me with a sketch of its spores in connection with the preparation of an earlier paper on *Oedocephalum* and *Rhopalomyces* published in 1891, (*Bot. Gazette*, Vol. XVI, p. 201). Material of *R. cucurbitarum* was also received from Prof. Peck, who collected it in New York; as well as from Ohio, where it was collected by Prof. Morgan; and in both instances the fungus proved identical with my New England Choanephora. An examination of the Curtis Herbarium at Harvard, moreover, brought to light specimens of the same plant under the name "*Aspergillus cucurbitaceus*" the material being labeled "Hillsborough, N. C., on squashes."

Having in mind the supposed tropical proclivities of Choanephora, I took advantage of the opportunity offered during a recent collecting trip in Florida to make cultures of various faded flowers, and at

¹ The species here referred to is redescribed by Matruchot in the January number of the new *Annales Mycologici* as the type of a new genus, under the name *Cunninghamella africana*. If this generic name is to stand, the species should be known as *C. echinulata*, since it was originally described by me as *Oedocephalum echinulatum* in 1891.

Eustis was rewarded by obtaining a luxuriant growth of *Choanephora* on flowers of a cultivated *Hibiscus*, as well as of a wild Malvaceous plant found in the vicinity. The species, however, proved identical with the New England form and greatly to my disappointment produced only conidial fructifications.

Choanephora cucurbitarum appears to be a very common form in the vicinity of Cambridge, and is no doubt widely distributed, at least in the eastern and southern states. Not only is it frequently found in the field growing usually on smaller squashes, but it may be readily obtained by making moist-chamber cultures of squash blossoms that have begun to fade, on which it may appear nearly pure, or mixed with other fungi. It seems somewhat remarkable that the considerable injury to squashes, for which it is responsible, is not referred to, as far as I am aware, by any of the Experiment Station workers who have the best opportunities for observing such diseases; although Mr. Peck has twice called attention to it, in his 43d and 45th Reports, and it is undoubtedly often responsible for the destruction of no inconsiderable percentage of the crop. In a majority of cases this injury appears to be due to the fact that the mycelium, which has attacked a fading flower, spreads readily thence to the young squash, the rapidly growing tissues of which it attacks like a true parasite, causing a soft rot. This rot may be very easily induced by cutting out a small plug from a young or full grown squash or pumpkin, and inserting a few spores, or a little mycelium, and replacing the plug. The mycelium spreads under these conditions with extraordinary rapidity, and in a few days involves the whole fruit in a watery decay. A coarse cottony mycelium appears at different points on the surface, and if the culture is kept only partly covered, so that the atmosphere is not too moist, an abundant coating of the conidial fructification will develop; which, to the naked eye, has the appearance of a luxuriant growth of some large *Mucor*, or of *Rhopalomyces strangulatus*. If the atmosphere is saturated, but few fructifications appear in such cultures, and the most luxuriant development of conidiophores seems to be adjusted within rather narrow limits, to the conditions of moisture present. On flowers, however, which furnish drier conditions, little difficulty is encountered in inducing the fungus to fruit abundantly in a moist chamber. On potato agar and similar nutrients in tubes, although the mycelium always develops rapidly and luxuriantly, fructifications very rarely appear. The

mycelium, however, in such cultures, retains its vitality for months through the concentration of the protoplasm in definite portions of the hyphae; without, as far as I have observed, producing the well differentiated chlamydospores which have been described in the other species.

The fertile hyphae (fig. 1) which are very variable in size, often reach a height of from five to six mm., and generally originate from the rapid enlargement of a slender branch from a vegetative hypha. They are whitish, with a more or less distinct purplish iridescence, and the inflated extremity may rarely bear the conidia directly, as in *Rhopalomyces*, but usually gives rise to from three or four to a dozen or more ramuli. The latter are commonly simple, but very frequently branched as in fig. 3, the tips swelling abruptly and forming secondary heads; the surfaces of which, by a process of budding (fig. 2), become covered by a layer of densely crowded spores (fig. 5). The conidia are rich purplish brown, appearing almost black in the mass, varying from oblong to short or long oval or elliptical in outline, and are marked by longitudinal striations which anastomose sparingly. The base of the spore is furnished with a more or less conspicuous, short, tongue-like, hyaline appendage; which is merely an adherent portion of the pedicel of attachment. The spores measure in well developed heads about $20 \times 10 \mu$, though larger, and frequently much smaller ones are found. They are caducous at maturity, leaving the sporiferous head beset with short spinulose projections, with corresponding faint areolations as in *Rhopalomyces*. Germination takes place very rapidly in water, or in nutrients; the copious mycelium developing at once.

The fate of the sporiferous ramuli and heads appears to be an important point in distinguishing the species of the genus, which owes its name to the fact that in the type, *C. infundibulifera*, the branchlet and the lower half of the sporiferous head become somewhat indurated, through the thickening of the membrane. The distal portion of the head being thin-walled, shrivels, and the persistent branchlet thus has the form of a little funnel. In *C. Simonsii*, the second Indian species, there is no such modification; but although the branchlet shrivels, it is more or less persistent. In our species, however, the ramuli not only shrivel, but are caducous at about the same time that the spores fall from their attachments, and leave the primary head (fig. 4) clathrate through the presence of rounded orifices corresponding to their insertions.

It is no doubt owing to this caducous character of the ramuli, that *C. cucurbitarum* has been so long confused with *Rhopalomyces*. It has been noted by both Cunningham and Moeller that the fructifications of these fungi usually mature very early in the morning, and the same is generally true of *C. cucurbitarum*. Any one collecting it in the field is thus likely to be misled as to its true characters; preparations of such material showing only masses of spores, associated with the persistent primary heads, the clathrate character of which is readily overlooked.

I have never been able to obtain the sporangia of this species, although it has been cultivated in abundance, and subjected to such unfavorable conditions of nutrition as are said, in the other forms, to induce this type of fructification. In the absence of any knowledge of the sporangia the synonymy of the species must remain uncertain; but, in so far as concerns the conidial fructification, it seems to be identical with the species described by Moeller as *C. americana*, unless the caducous character of the ramuli, which is not referred to¹ in his description, may prove to constitute a sufficient distinction. The habitat is the same, while the form and variations of the fructification are exactly similar; the spore measurements and shapes are identical, the exospore is of the same color and similarly striate, and the tongue-like remains of the attachment form a similar appendage in both. Yet the two cannot be certainly united until the identity of the sporangial spores can be determined. The latter are peculiar in this genus and, although they are contained in nodding sporangia which are very *Mucor*-like, are unique, in two of the species, from the fact that they are furnished with tufts of hair-like appendages which project from either end.

The zygospores are known only in the two Indian species, which appear to produce them abundantly, and present no noteworthy peculiarities as compared with those of other mucors: and although the *Peronospora*-like parasitism of *C. Simonsii* on living leaves and shoots of *Ipomoea*, together with the lateral production of conidia which sometimes occurs, is certainly remarkable, it does not seem, in the absence of any indication even of heterogamy in the sexual reproduction, a sufficient reason for believing with Cunningham that the genus forms a stepping stone to the *Peronosporae*. Nor does

¹ Since the above was in press Dr. Moeller has informed me that he finds the conidial fructification of our species identical with that of *C. americana*.

it appear to me that this genus, however interesting in itself, throws any important light on the at best dubious relationships which may be supposed to exist between the Oomycetous and Zygomycetous fungi.

Few references to our species appear in the literature under its original name; the description of Berkeley, and three notices of its occurrence in Peck's Reports, being, as far as I am aware, the only ones which deal with it at first hand. In a note concerning it in my revision of *Oedocephalum* and *Rhopalomyces* above referred to, I suggested that it might prove a variety of *R. elegans*, basing this opinion on the notes and sketches kindly sent me by Mr. Massee who examined the type at Kew: and in a later paper Marchal (*Revue Mycol.* Vol. XVI, p. 11, Jan. 1893) has assumed that this is actually the case, since he includes it in his enumeration of the species of this genus under the name *Rhopalomyces elegans*, var. *cucurbitarum*.

In this connection it may be suggested that the conditions found in *Choanephora* render it not at all improbable that the species of *Rhopalomyces*, all of which have dark spores and highly differentiated sporophores rising from a mycelium of unseptate hyphae, may eventually find a place among the Zygomycetes, when their perfect condition is discovered. It is worthy of note, however, that the conidial spores differ markedly in the two genera, from the fact that while those of *Choanephora* germinate very readily and with great rapidity, those of *Rhopalomyces* can usually be induced to do so with very great difficulty if at all.

The synonymy of our species may be appended as follows:

***Choanephora cucurbitarum* (B. & Rav.)**

Rhopalomyces cucurbitarum, Berkeley and Ravenel, *Grevillea*, III, p. 11, 1875.

Rhopalomyces elegans var. *cucurbitarum* Marchal, *Revue Mycologique* XVI, p. 11, 1893.

Aspergillus cucurbitaceus Curtis in Herb.

to which may be added with a query,—

Choanephora americana A. Moeller, *Schimper's Botan. Mittheil. a. d. Tropen.* Heft 9, *Phycomyceten u. Ascomyceten*, p. 18, Plate I, figs. 1-4.

2. **Notes on Monoblepharis.** In a paper published in 1895 (Botanical Gazette, Vol. XX, p. 433 with plate) I gave a short account of certain species of this alga-like genus which were found growing on submerged branches in pools near Cambridge and elsewhere; two new and striking forms being described as *M. insignis* and *M. fasciculata* respectively. The discovery of these plants was a matter of considerable interest at the time, for the reason that no members of the genus had been seen since the two original species on which it was founded (*M. polymorpha* and *M. sphaerica*) were observed by Prof. Cornu of Paris, twenty-five years earlier (1870): some persons even going so far as to doubt the very existence of a genus of fungi having the unique characters which he described. Anyone, however, who knows when, how and where to look for them will find no difficulty in obtaining them; and since the publication of my previous note at least two persons, Professor Lagerheim in Sweden and Dr. Minden in Germany, have again encountered them in Europe.

Lagerheim (Bihang till k. Vet.-Akad. Handlingar, Band 25, Afd. III, No. 8, 1899) in the second part of his "Mycologische Studien," has published his interesting observations; and describes in detail two species, one of them new (*M. brachyandra*) and another which he considers a variety of Cornu's *M. polymorpha*. In connection with this account he takes occasion to subdivide the genus, recognizing two subgenera under Monoblepharis, and placing the two forms described by myself in a new genus *Diblepharis*; basing this separation largely on the fact that, in these species, zoosporangia occur which are morphologically the equivalents of oogonia, and in which biciliate zoospores are produced; apparently overlooking the statement in my former paper (l. c., p. 438) that they were *not* peculiar in this respect. The fact that this new name has been accepted in other quarters has led me to publish the present note, although I have been reluctant to do so in anticipation of a thorough examination of our New England forms which I have had in view.

The oogonia of these fungi, which are terminal or intercalary enlargements of the main hyphae, or of short branches from them, or of both combined (figs. 7, 8, 10), have a more or less characteristic form in the different species; and with few exceptions are typically associated with a finger-like antheridial cell, which appears to be inserted on them, and is in all cases the terminal cell of a hypha, or

branchlet, which has been cut off by a septum from the oogonium which later forms below it. In some instances the antheridia may normally arise in an intercalary fashion like the oogonia, in others, again, both conditions may occur (fig. 10). In a majority of cases typical antheridia may be formed apart from oogonia, while in two this diclinous habit seems to be invariable. In several species, also, these solitary antheridia are associated with larger clavate organs resembling the sporangia of some Saprolegneae, and between the two forms there usually appear a variety of intermediate conditions. These larger clavate organs have been assumed to be zoosporangia containing uniciliate zoospores, but although Lagerheim describes and figures the germination of one of the latter which we must assume he followed continuously from its exit from the sporangium to its germination, the possibilities of error in such observations are so numerous that it cannot be regarded as finally settled that these structures are not all more or less modified antheridia.

Whether these structures are in reality sporangia or are merely more luxuriantly developed antheridia is, however, a matter of little importance in connection with the main point which I desire to emphasize; namely that the species of *Monoblepharis* are characterized by the production of zoosporangia which are the morphological equivalents of the oogonia, and in which biciliate zoospores are produced. This is not only true of the two forms which Lagerheim has set apart under *Diblepharis*; but of all the other species including his own *M. brachyandra*, a variable species which appears to occur not infrequently in the vicinity of Cambridge. These sporangia (figs. 8, 9 and 11) show the variations of form characteristic of the oogonia of the species in which they occur, and may be distinguished, after the zoospores (fig. 12) have escaped, by the residual globule or globules of oil which are conspicuous in them before and for some time after the spore discharge.

Although theses porangia are less commonly produced in some species than in others, and their abundance varies in different specimens, I have seldom examined material in which they did not occur; and in *M. polymorpha* especially, they may almost wholly replace the oogonia. It seems very improbable, in view of these facts, that such organs are not equally characteristic in European material, and it is necessary to assume that they have been overlooked. That they are not accidental or unusual productions, is beyond question; and it is

safe to assume that they are to be looked upon as *the* characteristic sporangia of the group. Although it would certainly add greatly to the already sufficiently remarkable peculiarities of this genus did its members possess, not only two kinds of sporangia, resembling antheridia on the one hand and oogonia on the other, but also two varieties of zoospores; the sporangial nature of the antheridium-like type may well be doubted until indubitable evidence has been obtained in corroboration of Lagerheim's observations.

The species of *Monoblepharis* appear to the writer to form so well defined and coherent a group that it seems undesirable to follow Lagerheim in subdividing it into genera, or even subgenera: for, although the forms may be conveniently sorted according as they mature their oospores within (endogynous) or without (exogynous) the oogonia, such an arrangement would include *M. insignis* and *M. fasciculata* in the same section with *M. sphaerica*, which is evidently more closely related to the exogynous *M. polymorpha*. Recognizing then but a single well marked genus, the species may be summarized as follows:

MONOBLEPHARIS *Cornu*.

* Oospores normally endogynous.

+ Oospores smooth.

M. insignis Thaxter. Oogonia large normally superposed in single series. Vicinity of Cambridge, Mass., and of Kittery Point, Me.

M. fasciculata Thaxter. Oogonia small, fasciculate at the tips of the hyphae. Vicinity of Cambridge.

+ + Oospores bullate.

M. sphaerica Cornu. Antheridium hypogynous. Vicinity of Paris, France.

* * Oospores normally exogynous.

+ Oospores adherent to mouth of oogonium.

M. polymorpha Cornu. Normally androgynous the antheridia inserted above the middle third of the oogonium. Vicinity of Cambridge and of Kittery Point. Vicinity of Paris, France and of Breslau, Germany (Figs. 7-8).

M. brachyandra Lagerheim. Normally androgynous, the antheridium arising from an abruptly distinguished insertion below the upper third of the oogonium. Vicinity of Cambridge.

+- + Oospores not adherent to mouth of oogonium.

M. macrandra, Lagerheim (as var. of *M. polymorpha*). Normally diclinous. Holma, Sweden.

In addition to these forms Prof. Lagerheim describes two doubtful species, *M. ovigera* and *M. regnigens*. Of these the first seems a very doubtful Monoblepharis while the second should, I think, certainly be excluded from the genus. A form closely resembling it was found at Kittery Point in the spring of 1896 in a permanent pond; but although the material was just beginning to produce zoospores, I had no opportunity to determine whether the latter were uniciliate, or to ascertain whether the sporangia were proliferous as in *M. regnigens*. The hyphæ, however, have the characteristic vacuolate contents which so clearly distinguishes members of this family, and we are probably dealing here with a new genus.

What I assume to be *M. polymorpha* is the most abundant species and can be found in almost any pond or swamp, being no doubt very widely distributed. The filaments are very slender with divergent branches often much attenuated. The oogonium-like sporangia are very common, and the oogonia are more frequently solitary, or not more than two or three together, in marked contrast to the succeeding species.

M. brachyandra, which is distinguished by a shorter stouter antheridium, differently placed and arising characteristically from an abruptly distinguished notch-like insertion which breaks the even outline of the oogonium, is further peculiar from the common occurrence of intercalary antheridia of the type shown in fig. 10. The spores tend to nearly smooth forms in the material examined, and I have been unable to distinguish the two varieties described by Lagerheim, the characters of which seem to be combined in the American material. I think, however, that there can be little question as to the identity of the Swedish and American forms. The zoosporangium represented in fig. 11 is unusually elongate and is drawn from fresh material killed and stained just as the zoospores were escaping. The antheridium which it bears is also abnormally elongated. The usual form of these sporangia is exactly like that of the oogonia.

M. macrandra, which is regarded by Lagerheim as a variety of *M. polymorpha*, I have never met with. It seems to be so well distin-

guished from Cornu's species by its normally diclinous habit, hyaline spores, copious oogonia and especially by its peculiar antheridia and unique habit of discharging its oospores into the water, that I have not hesitated to separate it as a distinct species in the above synopsis.

In addition to the forms above enumerated there appear to be at least two, if not more, additional species which occur in New England; but I prefer to withhold further notes concerning these, in the hope of having an opportunity to examine them more thoroughly in the near future.

In this connection I am tempted to express my dissent from the views of Lagerheim regarding the possible points of approach that may be indicated between these fungi and existing algæ which, at the present time, might be assumed to represent their algal progenitors. In his opinion one should look to forms related to Oedogonium or Coleochaete, rather than to Vaucheria, in seeking such a point of departure; basing this opinion mainly on the fact that the oogonium in these genera is permanently uninucleate, while that of Vaucheria, before the exit of the supernumerary nuclei, is multinucleate. Apart from the fact that we do not as yet know whether the uninucleate condition in Monoblepharis or the preliminary multinucleate condition in Vaucheria are constant phenomena in all the species, it does not appear to be by any means certain that such a difference, even were it constant, should be looked upon as phylogenetically important, in view of the cytological eccentricities presented by other coenocytic plants and so well illustrated in the genus Albugo. The fact that both Oedogonium and Coleochaete possess a thallus of a totally different nature would in itself be a strong argument against such an origin. On the other hand one finds in Vaucheria not only a close resemblance in the Siphonaceous thallus, but so remarkable a correspondence in the phenomena of sexual reproduction that it is merely necessary to select a species like *Vaucheria intermedia*, in which, through a similar sequence in formation, the antheridia appear as in Monoblepharis to be inserted on the oogonia, deprive its thallus of chlorophyl and its antherozoids of one cilium, and supply it with biciliate zoospores, to obtain a very presentable species of Monoblepharis. The transformation of the zoospores would perhaps be the most violent step in this process; yet even in the Phycomycetes themselves our ideas of what a zoospore should be in this group are rudely overturned by such a form as Myrioblepharis.

EXPLANATION OF PLATE 46.

Choaneophora cucurbitarum (Berk).

Fig. 1. Mature fertile hypha bearing about twelve secondary sporiferous heads, $\times 100$.

Fig. 2. Terminal portion of a similar hypha; the spores just beginning to bud from the surface of the head, $\times 100$.

Fig. 3. Primary head from which the fertile ramuli are developing, one at the right furcate, $\times 390$.

Fig. 4. Primary head from which the ramuli have fallen leaving it clathrate $\times 390$.

Fig. 5. Sporiferous secondary head, $\times 175$.

Fig. 6. Spores, 860.

Monoblepharis polymorpha Cornu.

Fig. 7. Three oogonia the two upper with mature exogynous oospores, $\times 390$.

Fig. 8. A zoosporangium and oogonium, 390.

Monoblepharis sp.

Fig. 9. Zoosporangium, $\times 500$.

Monoblepharis brachyandra Lagerh.

Fig. 10. Two mature oogonia above an intercalary antheridium, $\times 390$.

Fig. 11. Zoosporangium with abnormally developed antheridium at right, $\times 930$.

Fig. 12. Biciliate zoospore, $\times 930$.

The figures are drawn with camera lucida and slightly reduced from the approximate magnifications indicated.

RECENTLY RECOGNIZED SPECIES OF CRATAEGUS IN
EASTERN CANADA AND NEW ENGLAND, — II.

C. S. SARGENT.

§ MOLLES.

Crataegus exclusa, n. sp. *Crataegus Pringlei*, Sargent, RHODORA, iii. 21 in part (1901). —

Leaves ovate, acute or acuminate, rounded, truncate or broadly cuneate at the glandular entire base, coarsely doubly serrate above, with straight gland-tipped teeth, and divided into three or four pairs of short acute lateral lobes; when they unfold coated above and on the midribs and veins below with long pale hairs, more than half grown, membranaceous and still slightly villose or nearly glabrous on the upper surface when the flowers open; at maturity thick and firm in

texture, dark yellow-green above, pale below, 6–7 cm. long, 5–6 cm. wide, with slender yellow villose midribs and veins; petioles slender, villose, sparingly glandular toward the apex, with large dark deciduous glands, often red in the autumn, 1.5–2.5 cm. in length; stipules linear, glandular, caducous. Flowers on stout pedicels, in broad compound many-flowered densely villose corymbs; bracts and bractlets linear to oblong-obovate, acuminate, glandular-serrate, caducous; calyx-tube narrowly obconic, covered with long thickly matted white hairs, the lobes narrow, acuminate, glandular-serrate, with bright red glands often only above the middle, villose, reflexed after anthesis; stamens 10; anthers rose color; styles 3–5, often furnished at the base with small tufts of pale hairs. Fruit drooping or erect on short stout pedicels, in many-fruited villose clusters, oblong, gradually narrowed to the full and rounded more or less hairy ends, or rarely ovate, bright cherry red, lustrous, marked by few large dark dots, 1.7 to 1.8 cm. long, about 1.3 cm. wide; calyx comparatively small, sessile, with a deep narrow cavity and linear acuminate lobes gradually narrowed from broad bases, coarsely glandular-serrate, villose-pubescent, dark red on the upper side near the base, reflexed and closely appressed or rarely erect and incurved; flesh thick, bright yellow, slightly juicy; nutlets 3–5, thin narrowed and acute at the ends, irregularly ridged on the back, with a high rounded ridge, 7–8 mm. long.

A broad shrub with numerous stout much-branched stems covered with ashy gray bark, 3–4 m. in height, and comparatively slender conspicuously zigzag branchlets marked by many small oblong pale lenticels, dark orange-green and covered when they first appear with scattered pale caducous hairs, bright red-brown and lustrous during their first season, darker reddish brown the following year, and finally ashy gray, and armed with numerous stout nearly straight bright chestnut-brown lustrous ultimately gray spines 3.5–5 cm. in length. Flowers during the last week of May. Fruit ripens late in September.

VERMONT: Open grassy slopes of Bald Mountain, Clarendon and Shrewsbury, *W. W. Eggleston*, September 30, 1899, May and August 1900, May, August and October 1901; *C. S. Sargent*, June and September 1900.

In the first account of *Crataegus Pringlei* the anthers were described as yellow. This mistake was subsequently corrected; and it now seems desirable to separate from that species the shrubby plants of Bald Mountain which I formerly considered as representing an extreme form of *Crataegus Pringlei*. *Crataegus exclusa* is a much more hairy plant, with stouter pedicels and much thicker broadly ovate not oval leaves, which show none of that tendency to droop

and become convex by the infolding of the two sides, a peculiarity which makes it always easy to recognize *Crataegus Pringlei* in the field. The habit of the Bald Mountain plant is also quite different from that of *Crataegus Pringlei* which is arborescent, with a tall well formed trunk.

CRATAEGUS ANOMALA, Sargent, RHODORA, iii. 74 (1901); *Silva N. Am.* xiii. 187, t. 670. During the season of 1902 Mr. J. G. Jack has found a number of trees of this species formerly known only in a few individuals, near Caughnawaga and on Ile Perrot in the St. Lawrence River. What appears to be *Crataegus anomala* has been collected at Crown Point, New York, by W. W. Eggleston, May 1902, and by Charles H. Peck, May and September 1902, and at Hampton, New York, by W. W. Eggleston, May and October 1902.

§ LOBULATAE.

CRATAEGUS LOBULATA, Sargent, RHODORA, iii. 22 (1901); *Silva N. Am.* xiii. 117 t. 75. A large tree of this species just out of bloom, with unusually hairy corymbs, was found on the 31st of May, 1902, by Ezra Brainerd and C. S. Sargent in a meadow by the road leading from Great Barrington to Alford, Massachusetts. *Crataegus lobulata* has also been collected at Stanford, Connecticut, by E. H. Eames, in May and September 1901, and September 1902.

Crataegus Robesoniana, n. sp. Leaves ovate, acute or acuminate rounded, truncate or rarely broadly cuneate at the base, sharply and often doubly serrate, with straight gland-tipped teeth, and divided into numerous short acute lateral lobes; nearly fully grown when the flowers open and covered above with short rigid pale hairs; at maturity membranaceous, light yellow-green and scabrous on the upper surface, pale and glabrous on the lower surface with the exception of a few short hairs scattered along the light yellow midribs and primary veins, 8-9 cm. long, 7-8 cm. wide, or on leading shoots often 10 cm. long and 9 cm. wide; petioles slender, nearly terete, occasionally glandular, often tinged with red in the autumn, 3-4 cm. long. Flowers about 1.5 cm. in diameter on stout pedicels covered with long white reflexed hairs, in very compact few-, usually 5-flowered compound corymbs; bracts and bractlets linear to oblong-obovate, glandular, caducous; calyx-tube narrowly obconic, villous, the lobes gradually narrowed from broad bases, linear, long-pointed, irregularly glandular-serrate, villous, reflexed after anthesis; stamens 10; anthers small, rose-purple; styles 4 or 5. Fruit in erect few-fruited clusters, oblong, full and rounded at the ends, bright scarlet, lustrous, marked by few large dots about 2 cm. long and 1 cm. wide; calyx sessile,

with a broad shallow cavity, and narrow elongated appressed lobes; flesh thick, juicy, pale yellow; nutlets 4 or 5, acute at the ends, slightly and irregularly ridged on the narrow back, 6–7 mm. long.

A tree 7 or 8 m. in height, with a tall trunk sometimes 3 dm. in diameter, stout wide-spreading or ascending branches forming an open shapely head, and slender mostly unarmed branchlets marked by many small oblong pale lenticels, olive green when they first appear, dull reddish brown during their first season, and pale red-brown and lustrous the following year. Flowers during the last week of May. Fruit ripens the first of September and soon falls.

MASSACHUSETTS: Borders of woods, usually in low moist soil. Lenox, *Brainerd* and *Sargent*, May 30, 1902; *C. S. Sargent*, September 8, 1902.

This species which is closely related to *Crataegus lobulata*, Sargent, differs from it in its compact few flowered corymbs, in the peculiar hairs which cover the pedicels of the flowers, in its remarkably thin leaves which are shorter in proportion to their length, much less deeply lobed and very rough on the upper surface, and in its early ripening fruit which falls at least a month earlier than that of *Crataegus lobulata*. The tree which should be considered the type of this species is growing on the estate at Lenox which was owned for many years by the late William R. Robeson of Boston, and was probably moved at least forty or fifty years ago from the woods in the neighborhood to its present position close to the front door of the house. The name of a family of Pennsylvania and Massachusetts which has produced at least four generations of intelligent and cultivated lovers of trees can thus properly be associated with this handsome plant.

***Crataegus polita*, n. sp.** Leaves ovate to oval, acute or acuminate, full and rounded, or on vigorous shoots sometimes truncate or subcordate at the base, slightly and often doubly serrate, with straight glandular teeth, and divided into numerous short acuminate lateral lobes; tinged with red and covered on the upper surface with short lustrous white hairs when they unfold, nearly fully grown when the flowers open and then membranaceous, light yellow-green and scabrate above and pale and glabrous below; at maturity thick and firm in texture, smooth and dull dark yellow-green on the upper surface, light yellow-green on the lower surface, 7–9 cm. long, 6–7.5 cm. wide, with slender yellow midribs deeply impressed above and four or five pairs of thin primary veins running to the points of the lobes; petioles slender, nearly terete, sparingly glandular toward the apex, often red in autumn, 2.5–3 cm. long. Flowers about 1 cm. in diameter on elongated slender pedicels, in broad open thin-branched glabrous

compound corymbs; bracts and bractlets small, linear, acuminate, glandular-serrate, caducous; calyx-tube narrowly obconic, more or less deeply tinged with red, the lobes narrow, elongated, acuminate, coarsely glandular-serrate, red at the apex, reflexed after anthesis; stamens 5; anthers rose-purple; styles 3 or 4. Fruit in erect few-fruited clusters, subglobose to short-oblong or rarely broadly obovate, bright, cherry red, lustrous, often blotched with green or yellow, marked by few large pale dots, 1-1.3 cm. long, 9-12 mm. wide; calyx small and sessile, with a comparatively broad deep cavity and elongated lobes gradually narrowed from broad bases, coarsely glandular-serrate, red on the upper side near the base, spreading or incurved, often deciduous from the ripe fruit; flesh thick, pale yellow, dry and mealy; nutlets 3 or 4, thin, acute at the ends, prominently ridged on the back, with a high rounded ridge, about 7 mm. long.

A broad round-topped shrub 3-4 m. high with few or many much branched stems covered with pale gray bark, often much roughened near the ground, and slender slightly zigzag glabrous branchlets marked by many small lenticels, olive green slightly tinged with red when they first appear, bright reddish brown during their first season, darker the following year, and usually only slightly armed with stout straight bright red-brown spines from 2.5-5 cm. in length. Flowers about May 20th. Fruit ripens and begins to fall during the first week of September.

CONNECTICUT: Open rocky pastures near the Niantic River, East Lyme, *C. B. Graves*, May 26 and September 6, 1902. MASSACHUSETTS: hill west of the main street of Great Barrington, and roadside between Great Barrington and Alvord, *E. Brainerd* and *C. S. Sargent*, May 31, 1902; Great Barrington, *C. S. Sargent*, September 9, 1902.

CRATAEGUS HOLMESIANA, Ashe, *Sargent Silva N. Am.* xii. 119, t. 676. A form of this species with glabrous or pubescent corymbs, slightly larger flowers and fruit which ripens from ten to twenty days later than the form figured in *The Silva of North America*, is common near Montreal where *Mr. Jack* has found it in several stations; it is also common in the neighborhood of Toronto and at Rochester, New York.

Crataegus fretalis, n. sp. Leaves ovate, acute or acuminate, full and rounded at the broad base, sharply and except towards the base mostly doubly serrate, with straight gland-tipped teeth, and divided into three or four pairs of short acute lateral lobes; tinged with red and covered when they unfold with short pale hairs, and more than half grown when the flowers open and then membranaceous,

pale yellow-green and scabrate on the upper surface and paler on the lower surface; at maturity thin but firm in texture, light yellow-green and almost smooth above, pale yellow-green below, 7-10 cm. long, 6-9 cm. wide, with slender yellow midribs and thin remote primary veins arching to the points of the lobes; petioles slender, nearly terete, often furnished above the middle with occasional minute dark glands, frequently tinged with red in the autumn, 2.5-3 cm. long. Flowers 2-2.3 cm. in diameter on slender pedicels, in small thin-branched 5-12-flowered glabrous compound corymbs; bracts and bractlets linear to ovate, glandular-serrate, small, caducous; calyx-tube narrowly obconic, the lobes narrow, elongated, acuminate, coarsely glandular-serrate mostly only near the middle, bright red at the apex, reflexed after anthesis; stamens usually 5, rarely 6 or 7, small, deep rose-color; styles 3. Fruit in few-fruited erect or drooping clusters, oblong to obovate, full and rounded at the ends, crimson, lustrous, 1.1-1.2 cm. long, about 1 cm. wide; calyx cavity deep and shallow, the lobes erect and incurved, often deciduous from the ripe fruit; nutlets 3, thin, acute at the ends, slightly and irregularly ridged on the back, 6 mm. long.

A tree 6 or 7 m. in height with a trunk rarely more than 1 dm. in diameter covered with gray bark separating into thin flakes near the ground and smooth above, long slender erect and spreading branches forming an open irregular head, and stout nearly straight branchlets marked by many small oblong pale lenticels, green more or less tinged with red when they first appear, bright reddish brown and lustrous during their first season, darker red-brown the following year, and slightly armed with stout straight red-brown shining spines 2-4 cm. in length. Flowers about May 20th. Fruit ripens at the end of September.

CONNECTICUT: Oak woods, Rumford's Point, Groton, close to the shore of Long Island Sound, *C. B. Graves*, May and September, 1902; and probably at Oxford, *E. B. Harger*, May and September, 1901.

***Crataegus Thayeri*, n. sp.** Glabrous with the exception of the hairs on the upper surface of the young leaves. Leaves ovate to obovate, acute, gradually narrowed from near the middle and concave-cuneate at the entire base, sharply doubly serrate above, with straight gland-tipped teeth, and divided into numerous narrow acuminate lateral lobes; tinged with red when they unfold and covered above with short pale hairs, and membranaceous when the flowers open, and then dark yellow-green, lustrous and scabrate on the upper surface and pale on the lower surface; at maturity dark green, lustrous and smooth above, pale below, 5-6 cm. long, 3.5-4.5 cm. wide, with stout yellow midribs deeply impressed above like the 5-7 pairs of

very prominent thick primary veins extending obliquely to the points of the lobes; petioles slender, more or less wing-margined above by the decurrent bases of the leaf-blades, slightly grooved, 2.5-3 cm. in length; stipules linear, acuminate, glandular-serrate, caducous. Flowers 1.6 cm. in diameter on slender pedicels, in broad many-flowered thin-branched compound corymbs; bracts and bractlets linear, acuminate, entire or finely glandular-serrate, caducous; calyx-tube broadly obconic, the lobes rather abruptly narrowed from the base, slender, elongated, acuminate, tipped with small dark red glands, glandular-serrate or rarely entire; stamens 10; anthers large, deep-rose color; styles 3-5. Fruit erect on short or long rigid pedicels, subglobose to oblong or obovate, full and rounded at the ends, orange-red, marked by occasional small pale lenticels, 1-1.4 cm. long, 8-10 mm. wide; calyx sessile, with a broad shallow cavity and spreading and closely appressed mostly entire lobes; flesh thin, yellow, dry and mealy; nutlets usually 3, full and rounded at the ends, ridged on the rounded back, with a low broad ridge, about 8 mm. long and almost as broad.

A wide round-topped shrub 3 or 4 m. in height with many intricately branched stems, and very stout much contorted branchlets dark green, lustrous, and marked by numerous large pale lenticels when they first appear, dull red-brown during their first season and dark gray-brown or brown tinged with red the following year, and apparently unarmed. Flowers from the 20th to the end of May. Fruit ripens from the 1st to the middle of September.

MASSACHUSETTS: Upland rocky pastures, West Boylston, *J. G. Jack, Mrs. John E. Thayer, C. S. Sargent*, May and September 1900, 1902.

This species, of which I have seen but two individuals, resembles in the shape of the leaves *Crataegus scabrida*, Sargent, of western New England and the St. Lawrence valley, with which it should be associated. The leaves, however, are more sharply and deeply lobed and their midribs and veins are much stouter and more prominent, and the fruit is erect, much smaller and more often subglobose. The specific name of this species testifies to my appreciation of the help which I have received during several years from Mr. and Mrs. John E. Thayer of Lancaster in my studies of *Crataegus* in central Massachusetts.

§ FLABELLATAE.

* Stamens 20.

+ Anthers rose color.

CRATAEGUS FLABELLATA Spach. Sargent, RHODORA, iii. 75 (1901).

This species, which is common in the valley of the St. Lawrence River in the neighborhood of Montreal, has been found at Walpole, New Hampshire, by *W. W. Eggleston*, October 1902, and at Crown Point, New York, by *W. W. Eggleston*, June and September, 1902, and by *C. H. Peck*, September 1902. A specimen with immature fruit collected by *Ezra Brainerd* at Ferrisburg, Vermont, July 1901, should perhaps be referred to this species.

Crataegus contigua n. sp. Leaves ovate, acuminate, full and rounded or broadly cuneate at the glandular base, coarsely and often doubly serrate, with straight gland-tipped teeth and deeply divided into five or six pairs of acuminate spreading lobes; about one third grown when the flowers open and then membranaceous, covered above with short white hairs and glabrous below; at maturity thin but firm in texture, dark green, lustrous and scabrate on the upper surface, pale yellow-green on the lower surface 6–8 cm. long, 4.5–7 cm. wide, with slender yellow midribs and thin primary veins extending to the points of the lobes; on vigorous shoots often broader than long, 7 cm. long, 7.5–8 cm. wide; petioles slender, nearly terete, frequently slightly wing-margined at the apex, glandular with scattered minute dark glands 3–5 cm. in length. Flowers 1.3–1.5 cm. in diameter on elongated slender pedicels, in many-flowered thin-branched glabrous compound corymbs; calyx-tube broadly obconic, the lobes abruptly narrowed from broad bases, linear, acuminate, entire or rarely furnished with a few small scattered glandular teeth, reflexed after anthesis; stamens 20; anthers small, pink; styles 3–5. Fruit in few-fruited drooping clusters, obovate at first when fully grown, becoming oblong and full and rounded at the ends at maturity, scarlet marked by occasional small pale dots; calyx cavity broad and shallow, the lobes spreading and appressed, often wanting from the ripe fruit; flesh thin, yellow; nutlets 3–5, usually 4, thin, acute at the ends, conspicuously ridged on the back, with a broad grooved ridge, about 8 mm. long.

A shrub 2–3 m. in height with numerous erect stems spreading into small thickets and stout nearly straight branchlets marked by few large pale lenticels, yellow-green when they first appear, light red-brown and lustrous during the first season and dull gray-brown the following year, and armed with stout nearly straight bright red-brown shining, ultimately ashy gray spines, 2.5–4.5 cm. long. Flowers during the first week of June. Fruit ripens about the 20th of September and soon falls.

VERMONT: banks of White River, Stockbridge, *W. W. Eggleston*, June, July and September 1901. Common.

+ + Anthers light yellow.

Crataegus irrasa, n. sp. Leaves ovate, acute, broadly cuneate or on leading shoots rounded at the base, lacinate, doubly, or below the middle mostly simply, serrate, with incurved glandular teeth; more than half grown when the flowers open and then covered with short lustrous white hairs and villose below along the slender midribs and thin veins arching to the points of the lobes; at maturity thin but firm in texture, dark green and lustrous on the upper surface, pale yellow-green on the lower surface, 5-6 cm. long, 4-5 cm. wide, or on leading shoots sometimes 7 cm. long and 8 cm. wide; petioles slender, slightly wing-margined at the apex, grooved, glandular, with minute dark red glands, 2-2.5 cm. long; stipules oblong-obovate and acuminate, to falcate, acuminate and auriculate on leading shoots, villose, glandular-serrate. Flowers 1.3-1.5 cm. in diameter on elongated slender densely hairy pedicels, in thin-branched 9-12-flowered villose narrow compound corymbs; bracts and bractlets linear, small, caducous; calyx-tube narrowly obconic, thickly coated with long pale hairs, the lobes gradually narrowed from broad bases, short, acute, glandular, with minute bright red glands, villose, reflexed after anthesis; stamens 20; anthers small, pale yellow; styles 4 or 5. Fruit drooping or erect on stout slightly villose pedicels, in broad many-fruited clusters, oblong, full and rounded at the ends, dark red, lustrous, marked by a few large pale dots, 1.2-1.4 cm. long, about 1 cm. wide; calyx prominent, with a short tube, a broad deep cavity and spreading closely appressed persistent lobes; flesh thin, soft and pulpy, orange color tinged with dull red; nutlets 4 or 5, full and rounded at the ends, ridged on the back, with a high wide deeply grooved ridge, 8 mm. long.

A shrub 3 or 4 m. in height with numerous stems spreading into broad thickets, and slender nearly straight or conspicuously zigzag branchlets marked by large oblong pale lenticels, olive green when they first appear, dark or light reddish brown during their first season, gray or light brown tinged with red the following year and ultimately ashy gray, and armed with numerous stout straight bright red-brown and shining ultimately ashy gray spines varying from 2.5-9 cm. in length. Flowers at the end of May and early in June. Fruit ripens at the end of September and occasionally does not fall until the following spring.

PROVINCE OF QUEBEC: Rocky fields, the borders of woods, and banks of the St. Lawrence River, at Sault au Ricollet on the north side of Montreal Island, *J. G. Jack*, May and September 1902. Common.

Distinguished from the closely related *Crataegus flabellata* by its

broader and thicker leaves, by its much more hairy corymbs and calyx, by its pale yellow anthers and by the color of the flesh of the ripe fruit.

* * Stamens 10. Anthers pale rose color.

***Crataegus fluviatilis*, n. sp.** *Crataegus acutiloba*, Sargent, RHODORA, iii. 76 in part, (1901).

Leaves ovate, acuminate, broadly cuneate or rounded at the base, sharply and mostly doubly serrate, with straight teeth tipped with dark glands and divided into 5 or 6 pairs of narrow acuminate spreading lateral lobes; tinged with red and villose above and along the midribs and veins below with long pale hairs when they unfold, more than half grown when the flowers open and then membranaceous, coated above with short shining white hairs and glabrous below; at maturity thin but firm in texture, smooth and dark yellow-green on the upper surface, paler on the lower surface, 5–6 cm. long, 3.5–5 cm. wide, with stout yellow midribs often becoming rose color in the autumn, and slender primary veins extending to the points of the lobes; petioles slender, grooved, slightly wing-margined at the apex, glandular, with numerous small dark red glands mostly deciduous before autumn, often rose color late in the season, 1.5–2.5 cm. in length; stipules linear to linear-obovate, glandular-serrate, caducous; on vigorous shoots leaves deeply lobed, with spreading acuminate narrow lobes, often 7–8 cm. long and 6–7 cm. wide, with short stout glandular petioles wing-margined below the middle. Flowers 1.5 cm. in diameter on elongate slender densely or slightly villose pedicels, in broad thin-branched more or less villose many-flowered compound corymbs; bracts and bractlets linear, glandular, small, caducous; calyx-tube broadly obconic, villose toward the base, glandular above, the lobes narrow, elongated, acuminate, entire or slightly and irregularly serrate, villose on the inner side above the middle, reflexed after anthesis; stamens 10; anthers pale rose color; styles 4 or 5. Fruit in broad many-fruited drooping glabrous or slightly villose clusters, oblong or rarely obovate, crimson, lustrous, marked by numerous small dots, 9–13 mm. long, 8–10 mm. wide; calyx sessile, with a broad shallow cavity, and spreading closely appressed usually entire lobes villose on the upper side; flesh thin, firm and yellow; nutlets 4 or 5, acute at the ends, conspicuously ridged on the back, with a narrow rounded ridge, about 6 cm. long.

A shrub with many slender erect stems spreading into small clusters and frequently 6 or 7 m. tall, and thin zigzag branchlets dark orange-green and slightly villose when they first appear, soon glabrous, marked by numerous oblong pale lenticels, bright red-brown and lustrous during their first season, pale orange-brown and lustrous in

their second year, and finally dark gray-brown, and armed with numerous stout often curved red-brown shining spines 3-4 cm. in length. Flowers at the end of May. Fruit ripens from the 1st to the middle of October.

PROVINCE OF QUEBEC: Dry limestone ridges near the south bank of the St. Lawrence River in the Caughnawaga Indian Reservation, and on Montreal Island at Highlands and Rockfield, *J. G. Jack*, September and October 1899, May and September 1901 and 1902.

AN INTERESTING FORM OF *LEERSIA ORYZOIDES*. — During the latter part of September, 1902, while collecting along the tidal shores of the Merrimac river near "the laurels" in the western part of Newburyport, Mass., in company with Mr. Oakes Ames and Mr. R. G. Leavitt, I chanced to examine an apparently sterile grass that grew on the tide-swept shores, and found it to be a cleistogamous, smooth *Leersia*. It grew to about fifteen inches in height, and its leaves were horizontally spreading, soft and flaccid. Several specimens were taken home, and a study showed them to be very similar to *L. oryzoides* Swartz. Several trips made in the vicinity of Seabrook, New Hampshire, to observe this species growing in the field resulted in the interesting discovery that while *L. oryzoides* is often cleistogamous when growing in air, it is always rough under such circumstances; but when growing submersed it is *always* cleistogamous and *smooth*.

On another trip to the Newburyport locality in company with Mr. M. L. Fernald, a diligent search revealed a patch extending up the shore from well within the influence of the tide to nearly out of its reach. The lower part of this patch was identical in all respects with the plants of my first collection, while the upper part was the typical rough form with exserted panicles, thus beautifully demonstrating the oddity to be a physiological form, produced by submersion. It may be described as follows:

L. ORYZOIDES forma **glabra**. Submersed or inundated regularly by tides; a few inches to $1\frac{1}{2}$ ft. tall, smooth; leaves horizontal, soft and flaccid, each bearing a cleistogamous panicle in its sheath, the terminal with sheaths swollen by the enclosed flowers, but never rupturing. Spikes as in the type, but with fewer setae. — ALVAH A. EATON, The Ames Botanical Laboratory, North Easton, Massachusetts.

WESTERN PLANTS AT CUMBERLAND, MAINE.—In the summer of 1902 three western plants, *Solanum rostratum*, Dunal, *Rumex maritimus*, L., and *Verbena bracteosa*, Michx., made their appearance in sandy waste soil at Cumberland Center, Maine. The first has been reported several times from other parts of Maine, and has been spontaneous around buildings at Cumberland for the last two or three years. *Rumex maritimus*, L., was collected on a salt marsh at Old Orchard, Maine, a few years ago by Mr. J. C. Parlin. The present station extends the range slightly further northward and inland. The third plant, *Verbena bracteosa*, Michx., has not, to my knowledge, been reported previously from Maine. All three species were doubtless introduced from the West by impurities in grain.—EDWARD B. CHAMBERLAIN, Washington, D. C.

LINUM CATHARTICUM ON CAPE BRETON.—In August last, while examining the excellent sketches of Cape Breton plants made by Mrs. John S. McLennan, I was much interested in the drawing of a delicate little flax-like plant with opposite leaves and white flowers. The plant was so unlike anything with which I was familiar that Mrs. McLennan kindly guided me to the spot near her home in Sydney where she had found the plant. There it abounded in damp spots in an open field, and sufficient flowering and fruiting material was secured for later identification. Comparison of the plant with European specimens shows it to be the Old World *Linum catharticum*, L., the Fairy Flax of English pastures, which has been once before reported in Nova Scotia—on waste ground at Pictou,¹ 120 miles in direct line and more than twice that distance around the coast from Sydney.

At Sydney the Fairy Flax is not in waste ground, but grows thoroughly wild, suggesting to the casual observer the Bluet (*Houstonia caerulea*) of our New England fields. It may, however, have been first introduced in ballast, as a small colony of ballast-weeds occurs on the wharf not far away; or it was more probably first introduced into the region in imported seed. Unlike our native species of flax, *Linum catharticum* has opposite leaves and white flowers, and by these characters it may be readily distinguished should it appear in other portions of eastern America.—M. L. FERNALD.

¹ Macoun, Cat. Can. Pl. i. 501.

THE EIGHTH ANNUAL WINTER MEETING OF THE VERMONT BOTANICAL CLUB was held at the University of Vermont on January 16 and 17. The attendance was the largest in the history of the Club and the program was crowded with good papers. President Brainerd discussed the violets of the state as at present understood; W. H. Blanchard reported from the vicinity of Westminster a number of interesting plants new to Vermont, and some new to science; Mrs. E. B. Davenport gave her recollections of "the shoemaker botanist," C. C. Frost; Professor E. A. Burt discussed the *Thelephorae* of Vermont; Mrs. N. F. Flynn reported the discovery of 41 additional species in Burlington and vicinity during 1902, making the total number of seed plants and ferns recorded for the local flora of this region 1066; Dr. G. T. Moore discussed the pollution of water supplies by algae. There were 15 other shorter papers presented.

The annual address was by Mr. Clifton D. Howe of the University of Chicago, upon Some Results of Deforestation in Vermont. Mr. Howe, in his capacity as field agent for the National Bureau of Forestry, has made an extended survey of the forests of the state during the past year. It is hoped that Vermont will soon fall into line with the other New England states in formulating a forestry policy which will tend to alter the present methods of destructive lumbering.

Seventeen new members were elected and the former officers reappointed, namely: President, Ezra Brainerd; Vice-President, C. G. Pringle; Secretary, L. R. Jones. It was the sentiment that the summer meeting, which occurs about July first, be held on Stratton mountain. As this is near the Massachusetts and New Hampshire lines it is hoped that botanists from the neighboring states may join the party. Any desiring to learn more definitely the dates and plans should address the secretary, at the University of Vermont, Burlington.—L. R. JONES, *Secy.*

THE following members of the CONNECTICUT BOTANICAL SOCIETY have been appointed as a committee to take charge of its work upon the lower cryptogams: *Bryophytes*, Professor A. W. Evans, New Haven; *Algae*, Mr. Isaac Holden, Bridgeport; *Fungi*, Dr. G. P. Clinton, New Haven.

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R. Thaxter del.

Why Not Spend the Summer in the Maine Woods?

EVERY BOTANIST enjoys bracing air and picturesque country, and if with these he can combine the pleasure of discovery his summer is a happy one. No region in the Eastern United States affords the real botanist such opportunity for the pursuit of his studies in the field as the northern two-thirds of Maine. For there he will find twenty thousand (20,000) square miles of forest rarely interrupted save by the innumerable glistening lakes, interlacing rivers and wild waterfalls, and the rough alpine peaks of unexplored mountains. Thoreau's description nearly sixty years ago of a bit of this great forest to the west of Katahdin might well have been written but yesterday :

"There it was, the State of Maine, which we had seen on the map, but not much like that, — immeasurable forest for the sun to shine on, that eastern *stuff* we hear of in Massachusetts. No clearing, no house. It did not look as if a solitary traveller had cut so much as a walking-stick there. Countless lakes, — Moosehead in the southwest, forty miles long by ten wide, like a gleaming silver platter at the end of the table; Chesuncook, eighteen long by three wide, without an island; Millinocket, on the south, with its hundred islands; and a hundred others without a name; and mountains also, whose names, for the most part, are known only to the Indians. The forest looked like a firm grass sward, and the effect of these lakes in its midst has been well compared, by one who has since visited the same spot, to that of a 'mirror broken into a thousand fragments, and wildly scattered over the grass, reflecting the full blaze of the sun.' "

This is the immense forest-park which we invite you to explore. Here you may find a quiet retreat by pleasant waters, in the shelter of giant cliffs; or if a lean-to or bark-hut are not to your liking you can "put up" at one of the log-camps or lodges already built and ready to give you royal welcome to the simple and wholesome life of the Maine woods. If, however, you prefer to cling a little closer to civilization, you will find comfortable quarters and accommodating hosts in the villages scattered here and there along the line of the BANGOR & AROOSTOOK as it makes its way northward across the wilderness. And even at the hotels you will not find yourself very far from the Maine woods, for a walk of a few minutes will bring you to the verge of the "immeasurable forest."

If you are a lover of northern plants you will have rare pleasure in a tramp across country from your temporary home. If you have been familiar with the rocky oak-woods of southern New England, nothing

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can be more fascinating than the damp moss-carpeted evergreen forest, such as you will find occupying the low plains and the cool mountain slopes throughout Northern Maine. You can enter vast stretches of such forest on all sides of *Moosehead Lake* and throughout the *Katahdin Iron Works* region, and all along the main line of the railroad and its various northern branches. Here beneath the tall spruces are the rare plants for which at home you have made long and vain pilgrimages:—the tiny Mitre-wort, *MITELLA NUDA*, with its lace-like petals, the elusive Sweet-Coltsfoot, *PETASITES PALMATA*, one year blossoming in abundance, and then failing for years to show another of its fragrant heads, and the delicate Tway-blades, *LISTERA AURICULATA*, *CONVALLARIOIDES*, and *CORDATA*, rarely seen except by the botanist ready to creep in the moss. Here, too, you will make many new acquaintances:—the strange Spurred Gentian, *HALENIA DEFLEXA*, with its interesting bronze and greenish clustered flowers; the little white *PYROLA MINOR* for which you have hunted in the White Mountains, and nearby its handsome relative, *P. ASARIFOLIA* with glossy leaves and flesh-colored flowers. Then here are the Club-mosses, *LYCOPodium COMPLANATUM*, *SABINAEFOLIUM*, and *SITCHENSE*, species unknown to many save from herbarium-specimens.

In the region of *Fort Kent* and *Van Buren* these spruce woods shelter very many more species which it is worth while to see:—the largest of the Rattlesnake Plantains, *GOODYERA MENZIESII*, the rare Arctic Fleabane, *ERIGERON ACRIS*, the remarkable local Wood Betony, *PEDICULARIS FURBISHIAE*, unknown outside the St. John Valley.

Where the woods grow thin and the ankle-deep carpet of Hypnum changes to a knee-deep carpet of sphagnum, you will find yourself entering one of the Sphagnum-bogs which cover many thousand miles of Maine and New Brunswick. Here, for instance near *Sherman*, *Crystal* or *Island Falls* on the upper Mattawamkeag, or in hundreds of other similar areas to the west and north, in late May and early June the bog is a brilliant display of color: white foam-like masses of the spicy Labrador Tea, *LEDUM GROENLANDICUM*, rich rosy banks of the Pale Laurel, *KALMIA GLAUCA*, indefinite white waves of the Alpine Cotton-grass, *ERIOPHORUM ALPINUM*, brightened here and there with the deep yellows of *Cypripediums*. Later these bogs will repeat this show of colors in other fine displays: white in *TOFIELDIA* or in the Swamp Valerian, *VALERIANA SYLVATICA*, scattered among the Bog Birch, *BETULA PUMILA*, and the Swamp Honeysuckle, *LONICERA OBLONGIFOLIA*; rose in the splendid *CYPRIPEDIUM SPECTABILE*; and orange in the northern Squaw-weed, *SENECIO ROBBINSII*. But these showy plants are not alone the attractive features of the bogs, for search will reveal humbler and to the botanist more pleasing returns,—rare *CARICES*, *C. TENUIFLORA*, *GYNOCRATES*, and *VAGINATA*, or the little Sundew, *DROSERA LINEARIS*.

If instead of to the evergreen forest your path leads over an upland

BANGOR AND AROOSTOOK RAILROAD.

ridge with its deciduous covering of sugar-maple, beech, and birch, you will again be in a happy hunting ground, for here, in the upland woods between *Houlton*, *Presque Isle*, and *Fort Fairfield*, is the home of *DICENTRAS*, *CLAYTONIAS* and *DENTARIAS*, of *VIOLA SELKIRKII*, the Seneca Snakeroot, *POLYGALA SENEGA*, the woodland orchids, *HABENARIA HOOKERIANA*, and *H. BRACTEATA*, and other species which brighten the woods of spring and early summer.

The dense woods, however, are not always the best botanizing grounds, and so, even in northern Maine, their charm is enhanced by the presence of a river. If you follow the ledgy and gravelly banks of one of these northern streams,—as the *St. John* between the *Little Black* and the *Aroostook Rivers*, or the Aroostook itself between *Masardis* and the splendid gorge as the river approaches the *St. John*—you will be always alert, for every turn is apt to bring you to some new discovery. It may be a bank pink with the long racemes of *OXYTROPIS*, *CAMPESTRIS*, var. *JOHANNENSIS*, or the equally handsome *HEDYSARUM BOREALE*, the globular heads of Chives, *ALLIUM SCHOENOPRASUM*, or the dainty evanescent flowers of *PRIMULA MISTASSINICA*. On some steep cliff by a water-fall you will see the rosettes of the Aromatic fern, *ASPIDIUM FRAGRANS*, the daisy-like heads of *ERIGERON HYSSOPIFOLIUS*, the glistening leaves of *SHEPHERDIA*, or the pink flowers of the rare *ANEMONE MULTIFIDA*. On the sandy beach you will find great thickets of northern willows, *SALIX GLAUCOPHYLLA*, etc., and a brilliant display of *ASTRAGALUS ALPINUS*, *TANACETUM HURONENSE*, and *PRENANTHES RACEMOSA*, interspersed with the less showy *EQUISETUM VARIEGATUM*, *TRIGLOCHIN PALUSTRIS*, and *JUNCUS ALPINUS*, var. *INSIGNIS*. Higher up the bank, on the talus-slope, are the delicate little Gentian, *GENTIANA AMARELLA*, var. *ACUTA*, and the handsome White Painted-Cup, *CASTILLEJA PALLIDA*.

If you follow the rivers you must not become so absorbed in the shore vegetation as to forget the aquatic plants. This is a land of lakes and ponds; and these and the channels by which they are emptied are often carpeted by plants too little known to the average botanist:—*MYRIOPHYLLUM FARWELLII* and *POTAMOGETON OBTUSIFOLIUS* in the *Piscataquis* and *Mattawamkeag Rivers* and their crystal-clear tributaries; and *MYRIOPHYLLUM ALTERNIFLORUM* and *JUNCUS SUBTILIS* in the *Mattawamkeag*, *Aroostook* and *St. John*.

The mountains of northern Maine, after all, are among the most fascinating regions for botanizing. If you have once lived on *Katahdin* you can never forget the wild grandeur of its Great Basin and the sheer cliffs and splendid Tableland. In exploring this most impressive of eastern mountains, one finds himself walking over broad carpets of the Alpine Bearberry, *ARCTOSTAPHYLOS ALPINA*, loaded with deep black berries, the depressed *RHODODENDRON LAPPONICUM*, gorgeous with rosy-purple flowers, the handsome *BRYANTHUS TAXIFOLIUS*, and the delicate pink-

BANGOR AND AROOSTOOK RAILROAD.

flowered *CASSIOPE* and the close-matted Alpine *Azalea*, *LOISELEURIA*. Then it is most thrilling to find in their alpine homes the other plants unknown on the lowlands, as *COMANDRA LIVIDA*, parasitic on the roots of alpine blueberries and crowberries, *CAREX SAXATILIS* and *KATAHDINENSIS* about alpine tarns, and *EPILOBIUM ANAGALLIDIFOLIUM* and *SAXIFRAGA STELLARIS*, var. *COMOSA*, hiding under cold wet boulders and cliffs.

But the greatest charm of the Maine woods for botanists is not in the regions which are now explored and whose vegetation is known. The regions of special interest are the hundreds of mountains, lakes and streams upon which no botanist has yet ventured. There you can go with the spirit of true discoverers, for everything you observe will be of some importance to science. These fields for real investigation are on all sides. For instance, there is only a very incomplete record of the vegetation about *Moosehead Lake*, and only two of its mountains, *Kineo* and *Squaw* have been botanically explored. Only three other large lakes in northern Maine have been visited by botanists and those — *Mattawamkeag*, *Squawpan*, and *Portage* — very superficially examined. No botanist knows *Schoodic*, *Seboois*, *Millinocket*, *Pamedumcook*, *Lobster*, *Chesuncook*, *Chamberlain*, *Caucomgomoc*, *Chemguasabamticook*, *Froid*, *Eagle*, and the countless other splendid waters like a "mirror broken into a thousand fragments and wildly scattered over the grass." Nor does he know the slopes, commanding summits and abysses of the *Sourduahunk Mts.*, *Traveller*, *Moosilauke*, *Baker*, the *Spencers*, and the hundreds of others "whose names are known only to the Indians."

The northwestern section of Maine is essentially virgin territory; and but one successful trip has been made on the upper *St. Francis*. Yet within a few miles of this Maine border there are many northern plants which may well be watched for within New England territory. The botanist whose good fortune takes him to the upper *St. Francis* may watch with hope for *PLEUROGYNE CARINTHIACA*, *ERIPHORUM RUSSEOLUM*, *ASTRAGALUS ELEGANS*, *PARNASSIA PALUSTRIS*, *SAXIFRAGA CAESPITOSA*, *ANEMONE PARVIFLORA*, *CORNUS SUECICA*, *PEDICULARIS PALUSTRIS*, and many other arctic plants known closely to approach northern Maine.

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